

# International Dark Sky Park

El Morro National Monument



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# Talk Outline

- Introduction
  - What are we doing?
  - Why does it matter?
- Past Work
  - NPS Natural Sounds and Night Skies Division w/ Utah State University: Night Sky Quality measurements taken May 30<sup>th</sup>, 2013
- Methodology
  - Night Sky Quality measurements
  - Application materials
- Results
- Conclusions



# International Dark-Sky Association



IDA Mission: to preserve and protect the nighttime environment and our heritage of dark skies through environmentally responsible outdoor lighting.

# Goal of the project

- Become an IDA International Dark Sky Park
  - 1) Take our own measurements
  - 2) Organize application materials

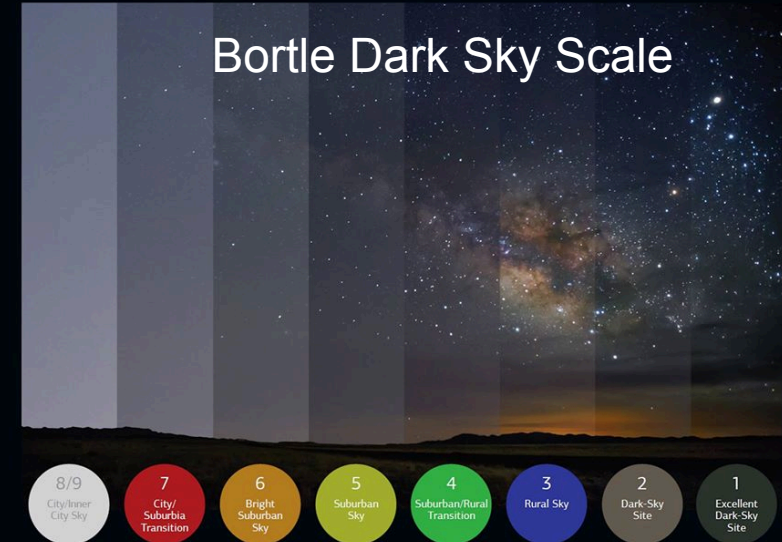


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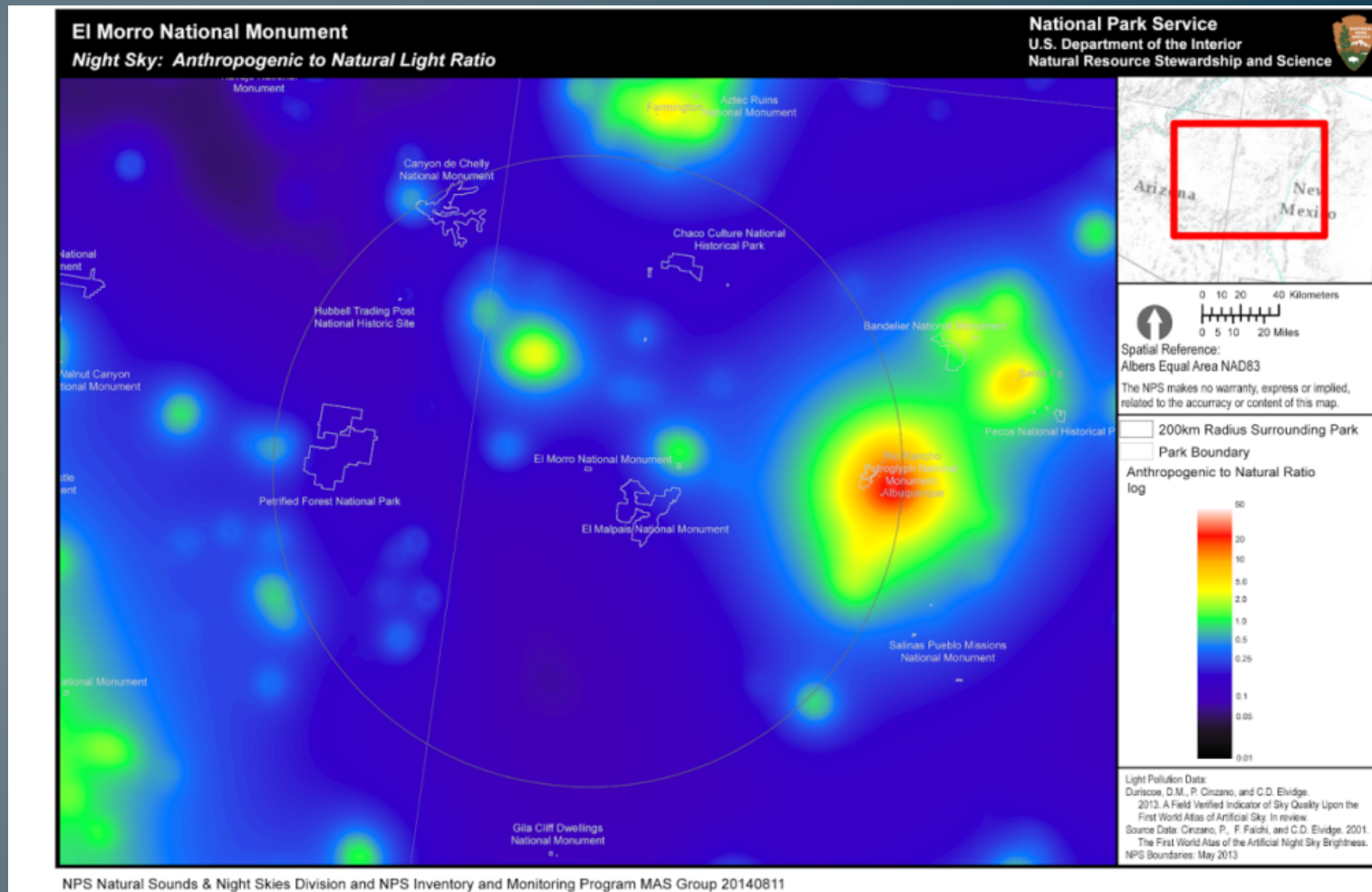
# Past Research

Indicator	Measure	Condition	Condition Rationale
Sky Brightness	All-sky Light Pollution Ratio*	Good	Sky brightness as measured by ALR indicates good condition at El Morro NM. This condition is based on NPS Natural Sounds and Night Skies Division benchmarks for non-urban parks and on the ground-based measurement of 0.20 taken in May 2013. The modeled ALR of 0.15 was derived from the 2001 World Atlas of Night Sky Brightness and is similar to the ground-based measurement. The ground-based measurement was collected by the NPS Natural Sounds and Night Skies Division. The confidence level is high.
	Maximum Vertical Illuminance	Good	Sky brightness as measured by maximum vertical illuminance was 0.12 milli-Lux at El Morro NM. This value reflects a rating of 31% above average natural conditions. Specific benchmarks for condition classes have not been set; however, condition is estimated as good (J. White, personal communication, Nov. 2015). This measurement was collected by the NPS Natural Sounds and Night Skies Division.
	Horizontal Illuminance	Good	Sky brightness as measured by horizontal illuminance was 0.06 milli-Lux at El Morro NM. This value reflects a rating of 7% above average natural conditions. Specific benchmarks for condition classes have not been set; however, condition is estimated as good (J. White, personal communication, Nov. 2015). This measurement was collected by the NPS Natural Sounds and Night Skies Division.
	Zenith Sky Brightness	Moderate	Zenith sky brightness indicates moderate condition at El Morro NM. This condition is based on NPS Natural Sounds and Night Skies Division benchmarks for non-urban parks and on a ground-based measurement of 21.54. Confidence level is high.
Sky Quality	Bortle Dark Sky Scale	Good	Sky quality as assessed by the Bortle dark sky scale indicate good condition at El Morro NM. This condition is based on NPS Natural Sounds and Night Skies Division benchmarks for non-urban parks and on the qualitative assessment of Bortle class 3, which is consistent with a rural night sky. Because this measure is qualitative, it has low confidence.





# Past Research



Modeled ALR map for El Morro NM with a 200km ring around the park illustrates the distance at which light can impact night sky quality within the park.

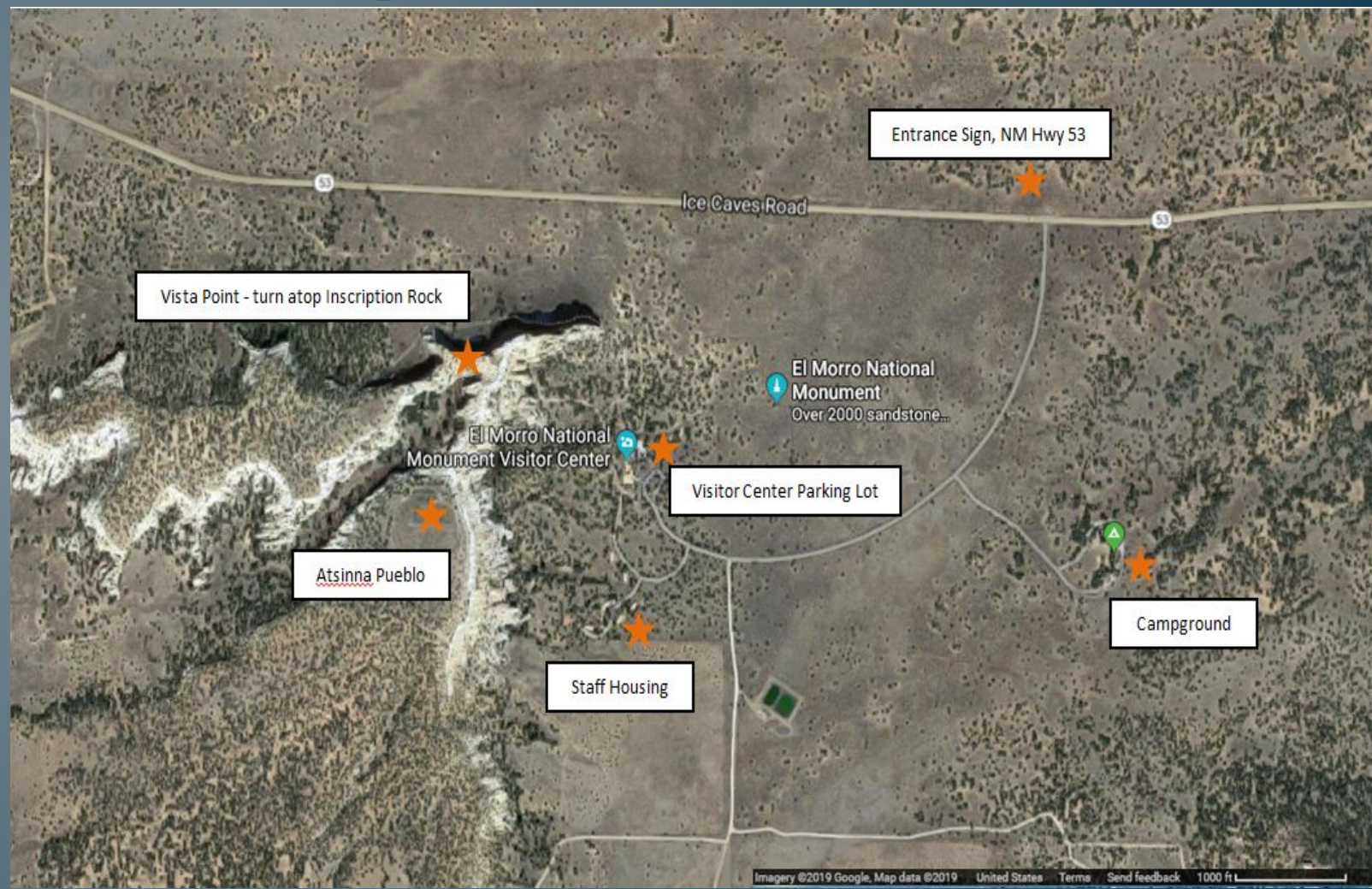
# Unihedron Sky Quality Meter (SQM-L)



Units = magnitudes per square arc second (msa)



# Monitoring Locations



# Measurements

Location	Average SQM-L Measurement	Date & Time (MST)	Average SQM-L Measurement	Date & Time (MST)
Staff Housing	21.53	11-26-2018 20:30	21.76	8-12-2019 04:20
Visitor Center Parking Lot	21.56	11-26-2018 20:20	21.66	8-12-2019 04:30
Entrance Sign Hwy 53	21.59	11-26-2018 20:10	21.70	8-12-2019 04:45
Campground	21.62	11-26-2018 20:00	21.73	8-12-2019 04:40
Atsinna Pueblo	21.44	11-27-2018 20:00	21.76	8-12-2019 05:00
Curve in Headland Trail	21.20	11-27-2018 20:20	21.65	8-12-2019 05:08
Average of 6 readings:	21.46		21.71	Total average of 12 readings: 21.59



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- Gain support from surrounding communities
- Host (at least) 4 Interpretive programs each year
- Lighting Management Plan
- Change light fixtures
- Submit application





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# Letters of Support

## Nominations

- Tyler Nordgren
- Superintendent

1. Inscription Rock Trading Co.
2. Feed & Seed
3. Ancient Way Café & El Morro Campground/RV Park
4. El Morro Area Arts Council (EMAAC)
5. The Albuquerque Astronomical Society (TAAS)
6. Grants Chamber of Commerce
7. Western National Parks Association (WNPA)
8. El Morro Market
9. Family Haven Farms
10. Ramah Navajo Chapter

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## Lighting Management Plan

### Visitor Center and Maintenance Building, Fixture Locations



● IDA compliant fixtures, and bulbs (<500 lumens) ● Non-compliant fixtures ● Wiring to fixture disconnected

### Housing Buildings, Fixture Locations



● IDA compliant fixtures, and bulbs (<500 lumens) ● Non-compliant fixtures

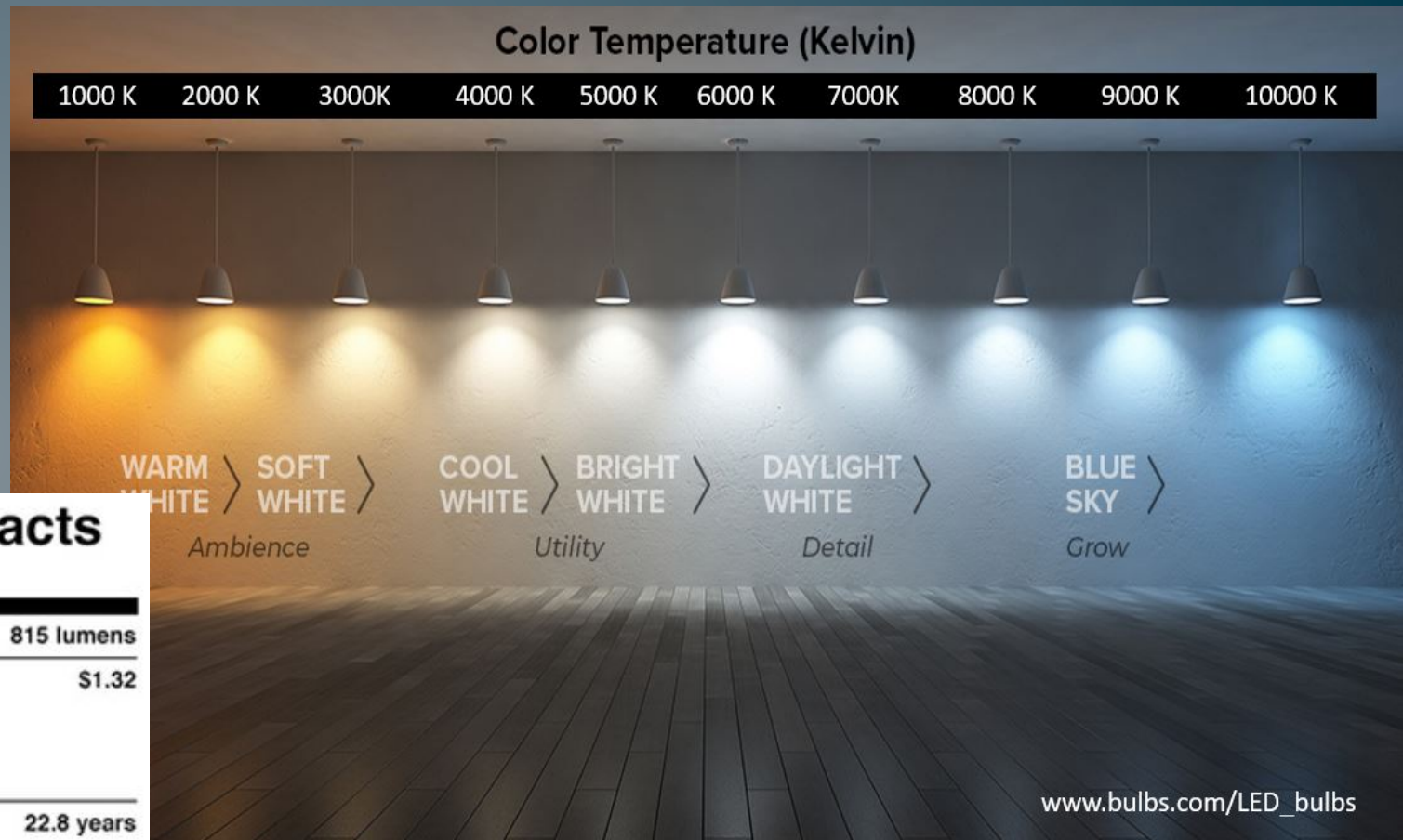
### Visitor Center and Maintenance Building, Fixture Types

1		Just replaced the bulb. Keep all these!	5		Just replaced the bulb. Keep all these!
2		Plan to replace with this:	6		Just replaced the bulb. Keep all these!
3		Painted inside of panels dark brown. This retrofit has allowed for us to keep the fixture, but now is fully shielded.	7		Had the historic base and we found a historic glass to cover this!
4		We plan to remove this light. No one even knew it was here, and there is another light right next to it.	8		These are disabled. If we do enable them, they are for safety and we can just put a plastic shield on them.

### Housing Building, Fixture Types

1		These two were replaced with:	5		This was replaced with:
2		These are historic, we can leave them. Bulbs have been changed.	6		This was replaced with:
4		These 2 fixtures are we are having trouble replacing due to the ceiling mount.	7		Confirmed that this is a modern fixture that was created to look historic. Will replace with:

# Correlated Color Temperature (CCT)



## Lighting Facts

Per Bulb

**Brightness** 815 lumens

**Estimated Yearly** \$1.32

### Energy Cost

Based on 3 hrs/day,  
11c/kWh. Cost depends  
on rates and use

**Life** 22.8 years

Based on 3 hrs/day

### Light Appearance

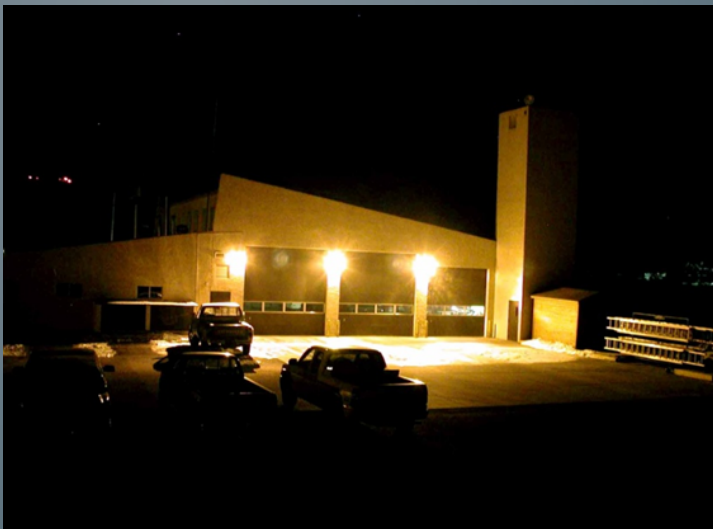
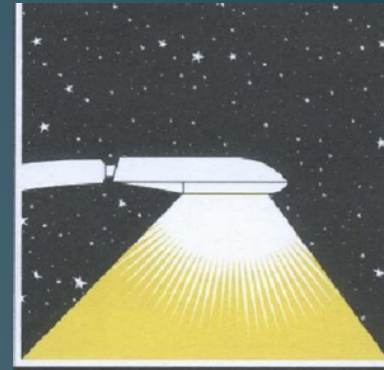
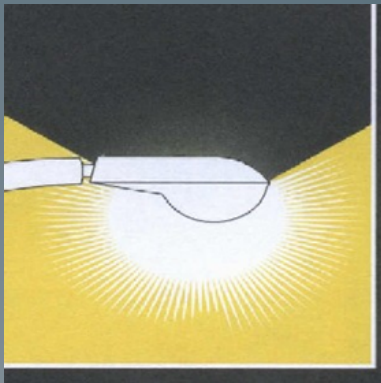


**Energy Used** 11 watts

[www.earthled.com](http://www.earthled.com)



# Fully Shielded Light Fixtures





# Historic Lights Will Remain!

*(Light bulbs are <500 lumens and <3,000 Kelvin)*



## Introduction – Past Work – Methodology – Results - Conclusions

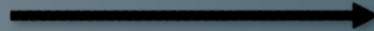


Light fixture retrofits to satisfy the  
State Historic Preservation Office  
(SHPO)





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# Results

- Improved data baseline; began data trend
  - Night Sky Quality is comparable, but brighter atop cuesta
- Created Management Documents
- Gained support from surrounding communities
- Certified as an International Dark Sky Park!



NPS Photo/Leslie Kobinsky



## Conclusion

- Continue night sky quality measurements
- Host 4 night sky programs each year
- IDA Annual Report
- Celebration event
- Recommendations





A long-exposure photograph of a night sky showing concentric star trails. The trails are composed of many short, overlapping lines of light in shades of blue, white, and yellow, creating a spiral effect. The bottom of the image shows the dark silhouettes of rocky terrain and trees against the starry sky.

With help from everyone, we can protect  
dark night skies for future generations.

Questions?



The End

# The world at night

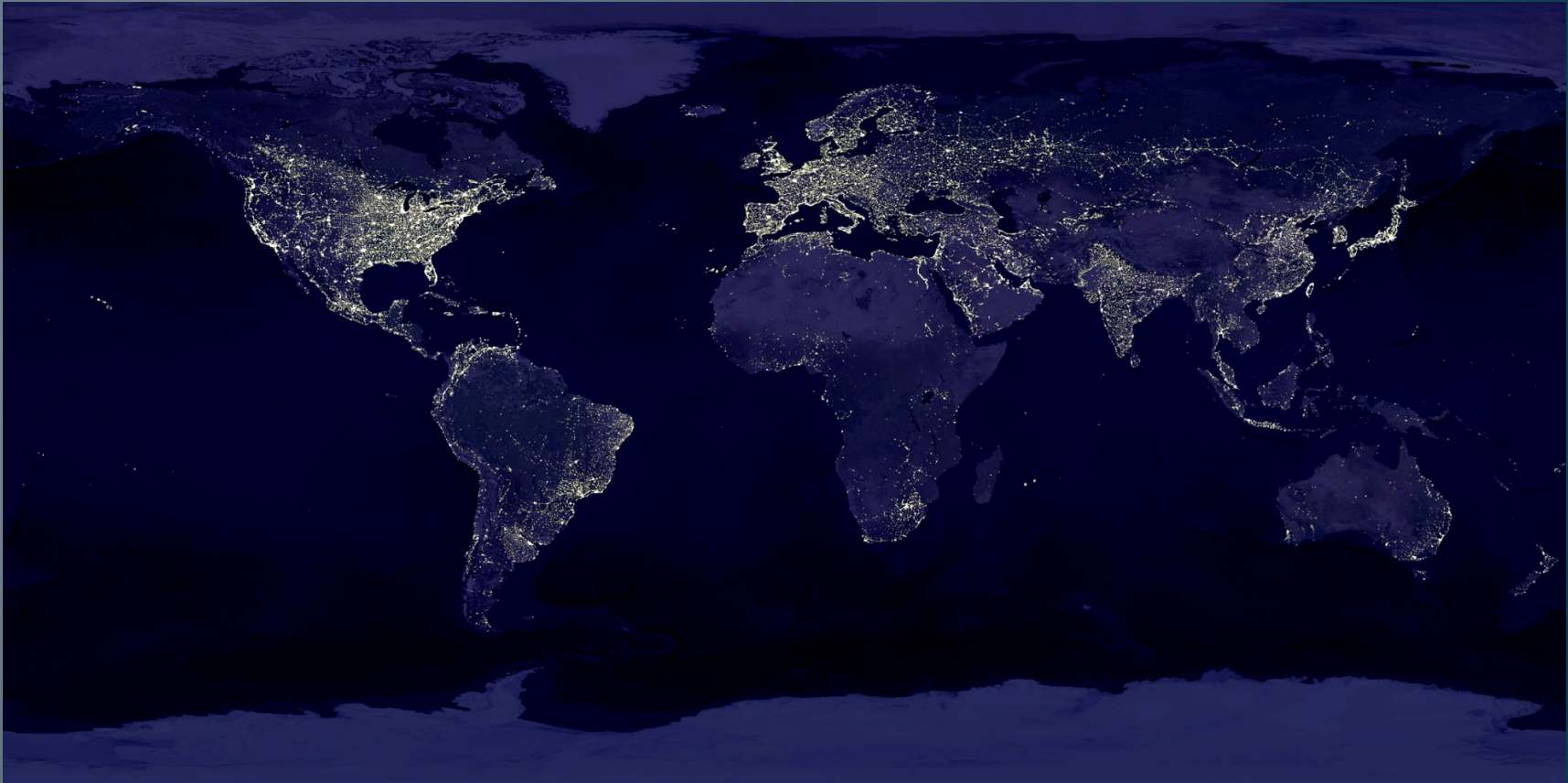
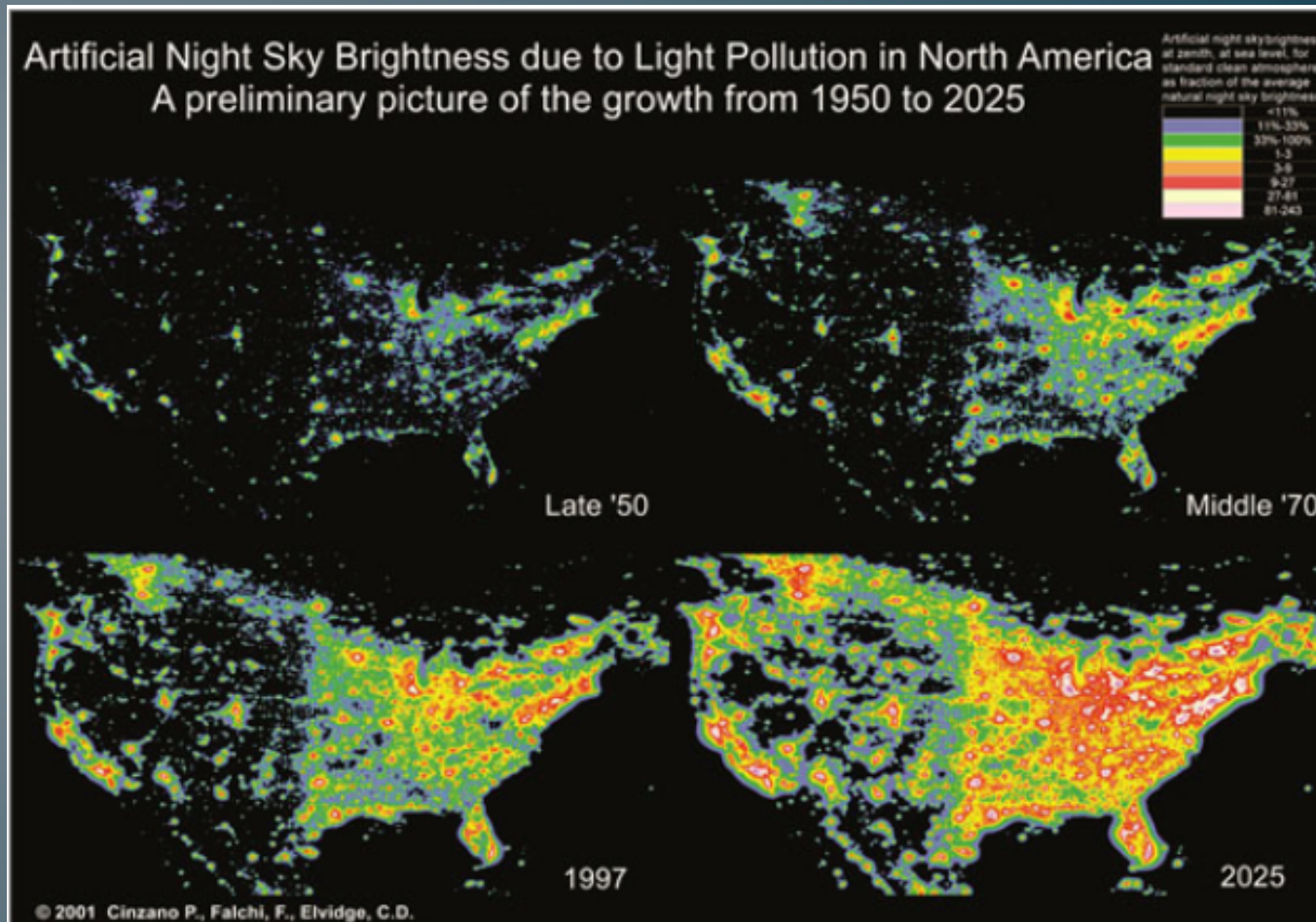


Image: Credit: Data courtesy Marc Imhoff of NASA GSFC and Christopher Elvidge of NOAA NGDC. Image by Craig Mayhew and Robert Simmon, NASA GSFC

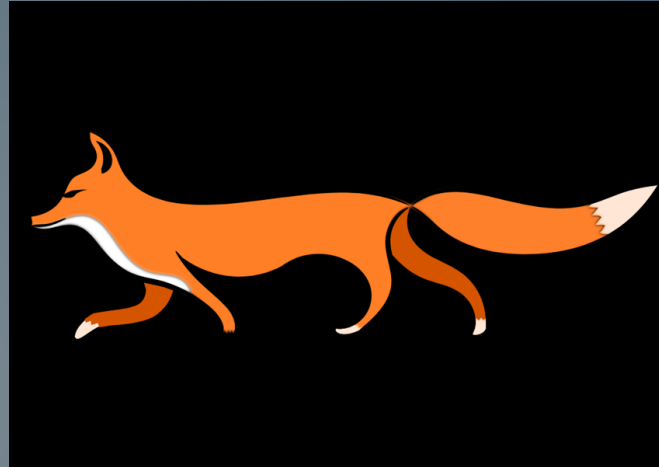
# 80% of Americans cannot see the Milky Way from where they live...



(Falchi, et al., 2016)



# Benefits of night sky protection:



The glare from unshielded lights impairs our night vision.



# Best Lighting Practices

Protecting the night sky starts with **YOU!**

**1** Light only what you need



**2** Use energy efficient bulbs and only as bright as you need



**3** Shield lights and direct them down



**4** Only use light when you need it



**5** Choose warm white light bulbs



**6** Join IDA!  
We need your help to continue the fight against light pollution.



Check out <https://www.darksky.org/> for more information!



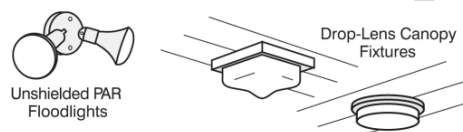
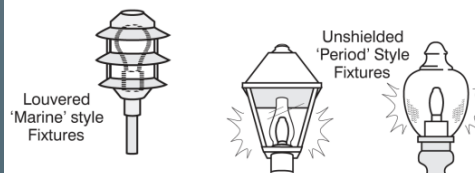
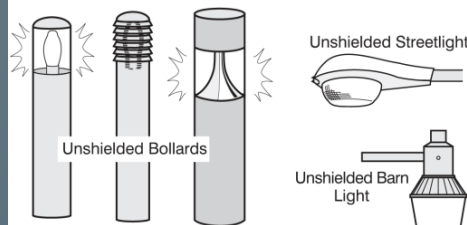
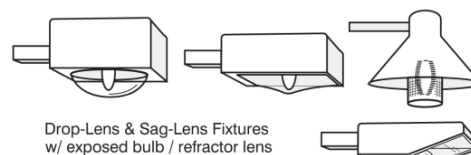
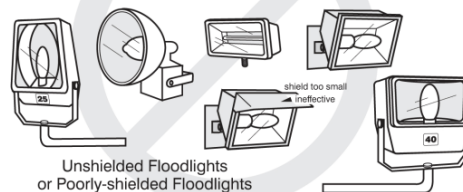
# Best Outdoor Lighting Practices

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## Examples of Acceptable / Unacceptable Lighting Fixtures

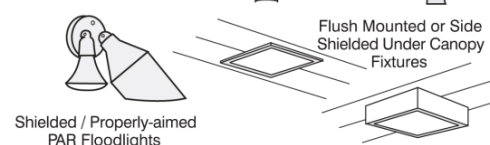
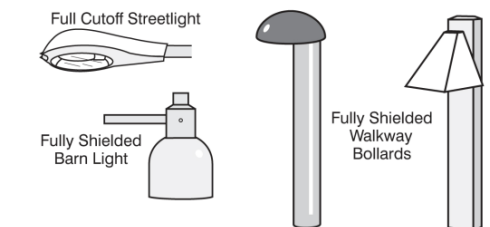
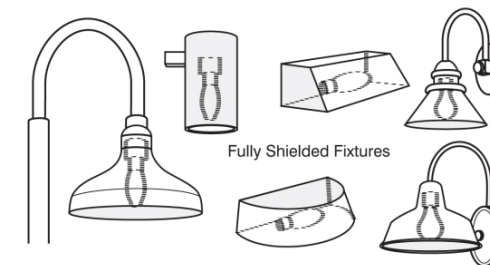
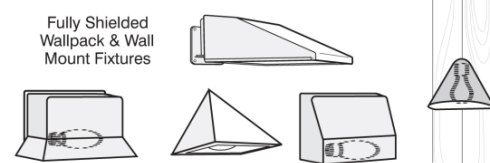
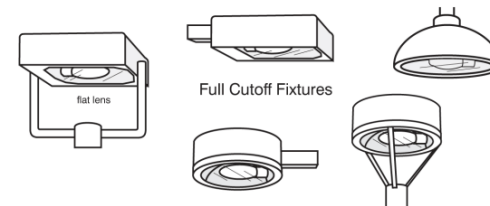
### Unacceptable / Discouraged

Fixtures that produce glare and light trespass



### Acceptable

Fixtures that shield the light source to minimize glare and light trespass and to facilitate better vision at night



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